A COMPARATIVE STUDY TO FIND THE EFFECTIVENESS OF PNF AND SIMPLE BALANCE TRAINING TO IMPROVE DYNAMIC BALANCE IN DIABETIC NEUROPATHY

DISSERTATION

Submitted for the partial fulfillment of the requirement for the degree of

MASTER OF PHYSIOTHERAPY (MPT)

(Elective-MPT Neurology**)**

April – 2018

By

Regn. No: 271620263

Submitted to:

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI – 600032.

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This is to certify that the Dissertation entitled "**A COMPARATIVE STUDY TO FIND THE EFFECTIVENESS OF PNF AND SIMPLE BALANCE TRAINING TO IMPROVE DYNAMIC BALANCE IN DIABETIC NEUROPATHY**" was done by the candidate Bearing Regn. No: **271620263.** This work has been done as a partial fulfillment for the degree of Master of Physiotherapy done at **Mohamed Sathak A.J College of Physiotherapy**, Chennai and submitted in the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University**.

Date:

Place: Chennai

Seal & Signature of Principal

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Prof. R. Radhakrishnan,MPT.,PGDHM.,(Ph.D)

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Date:

Place: Chennai Signature of Guide

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Prof. Parvathi, MPT(Neuro), M.SC(Psychology)

CERTIFICATE

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This is to certify that the Dissertation entitled **"A COMPARATIVE STUDY TO FIND THE EFFECTIVENESS OF PNF AND SIMPLE BALANCE TRAINING TO IMPROVE DYNAMIC BALANCE IN DIABETIC NEUROPATHY**" was done by the candidate Bearing Regn. No: **271620263.** The undersigned examiners has duly verified and examined the submitted Dissertation done by the above candidate.

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Internal Examiner External Examiner

DECLARATION BY THE CANDIDATE

I hereby declare that the Dissertation entitled "**A COMPARATIVE STUDY TO FIND THE EFFECTIVENESS OF PNF AND SIMPLE BALANCE TRAINING TO IMPROVE DYNAMIC BALANCE IN DIABETIC NEUROPATHY**" was done by me for the partial fulfillment of the requirement of Master of Physiotherapy degree. The dissertation had been done under the direct supervision and guidance of my Guide at **Mohamed Sathak A.J college of Physiotherapy**, Chennai, and submitted the same during the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University**.

Date :

Place : Chennai

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Signature of the Candidate

INDEX:

Abstract

Abstract:

A Comparative Study to find the Effectiveness of PNF and Simple Balance Training to Improve Dynamic Balance in Diabetic Neuropathy

Introduction: Diabetic Neuropathy plays a significant role in falling among elderly patients. People with peripheral neuropathy caused by diabetes often experience balance disorder, postural sway in these patients is increased, especially with the eyes closed. Peripheral neuropathy caused by diabetes causes significantly impaired sensation in the feet, reducing patients ability to control their balance properly during daily activities. Poor balance can be due to proprioception impairment. Balance problems are also caused by movement strategy impairment, biomechanical structural disorders and disorientation.

Aim: The aim of the study is to compare the effectiveness of Proprioceptive Neuromuscular Facilitation and Simple Balance Training to improve Dynamic Balance in Diabetic Neuropathy.

Need for the study: Very few studies have been conducted to show the effects of balance training in diabetic neuropathy.

Method:

- Sample size 30 patients
- Group A- Proprioceptive Neuromuscular Facilitation
- Group B- Simple Balance Training

Inclusion criteria:

- Age group 50-70 years
- Diabetic
- Michigan Neuropathy Screening Instrument score $\geq$7 to $\geq$4

Exclusion criteria:

- Foot ulcers
- Vision impairment

- History of dizziness
- Internal otitis (Labrynthitis)
- Any other vestibular diseases
- Musculo-skeletal disorders
- Rheumatic disorders
- Total/ Partial amputation of lower extremities
- Fractures
- History of spinal injury/ surgery
- History of lower limb surgery

Evaluation of Diabetic Neuropathy:

Michigan Neuropathy Screening Instrument

Procedure:

Group A: PNF techniques

- Rhythmic initiation
- Sustain-Relax
- Reversal of Antagonists

Protocol:

1st week - 10 Repetitions

2nd week - 2 sets of 10 Repetitions

3rd & 4th week - 3 sets of 10 Repetitions

Duration: 40 minutes

5 days per week for 4 weeks

Group B: Simple Balance Training

Protocol:

- Walking training section
- Balance training section
- Muscle strength training section

Duration: 40 minutes

5 days per week for 4 weeks

Variables:

- ✓ The 3m Timed up and go test
- ✓ The Functional Reach test

Introduction

INTRODUCTION:

Diabetic neuropathy is a nerve damaging disorder associated with diabetes mellitus. This condition is thought to be resulting from a diabetic microvascular injury involving small blood vessels that supply nerves (vasa nervorum) in addition to macrovascular conditions that can accumulate in diabetic neuropathy.[15]

More than 220 million people worldwide have diabetes. Diabetic polyneuropathy affects up to 50% of people with diabetes and usually starts with lesions on peripheral sensitive nerves and progresses to motor and autonomic nerves. It causes progressive loss of vibratory, thermal, tactile, proprioceptive sensitivities, following this sequence of incidence.[19]

Diabetic Neuropathy plays a significant role in falling among elderly patients. People with peripheral neuropathy caused by diabetes often experience balance disorder, postural sway in these patients is increased, especially with the eyes closed. Peripheral neuropathy caused by diabetes causes significantly impaired sensation in the feet, reducing patient ability to control their balance properly during daily activities. Poor balance can be due to proprioception impairment. Balance problems are also caused by movement strategy impairment, biomechanical structural disorders and orientation.[15]

Lack of accurate proprioceptive information from the lower extremities in distal sensorimotor polyneuropathy patients has resulted in postural instability during different static and dynamic situations, especially when the body is exposed to unexpected postural perturbations. Therefore, they are at a high risk for falling and its life-threatening consequences.[17]

Balance is generally defined as the ability to maintain the body's center of gravity within its base of support and can be categorized by either static or dynamic balance.[21]

Dynamic balance is the horizontal movement of the centre of gravity even when a person is standing still. Dynamic balance is believed to be more challenging because it requires the ability to maintain equilibrium during a transition from a dynamic state to a static state.[10]

Both static and dynamic balance require effective integration of visual, vestibular, and proprioceptive inputs to produce an efferent response to control the body within its base of support. An interruption or deficit in any part of the sensori-motor system can result in a loss of balance, which can result in injury.[10]

In the early 1990s, Sherrington defined the concepts of neuromuscular facilitation and inhibition, which subsequently led to the development of clinical PNF stretching by Kabat. Initially, PNF techniques were used to aid the rehabilitation of clients with spasticity and paresis by either facilitating muscle elongation, supposedly through enhanced inhibitory mechanisms. The therapeutic use of PNF for clients with conditions other than those of neurological origin soon followed.[7]

Proprioceptive Neuromuscular Facilitation (PNF) is a method that uses diagonal and spiral movements, aiming at facilitating, strengthening, gaining control and coordinating movements to activate proprioceptors that are located in the joints, tendons and muscles consequently improving the motor functions.[24]

PNF improves the functions of proprioceptors by stimulating them in the muscles and tendons. It also increases muscle strength, flexibility and balance, and enhances co-ordination. It is effective at eliciting the maximal responses of motor units.[22]

Simple Balance Training is a exercise training programme developed using general activities in daily life living of aging to improve their balance ability.[21]

Enhanced balance training exercises are designed to improve confidence, mobility, and functioning in a day to day context. Balance training includes equilibrium control exercises that are repetitive and graded in complexity that enhance balance by improving sway control and inhibiting inappropriate motor responses.[5]

Hence, this study was designed to determine the effectiveness of Proprioceptive Neuromuscular Facilitation and Simple Balance Training in improving Dynamic Balance in Diabetic Neuropathy.

Objective of the study

OBJECTIVE OF THE STUDY:

1. To study the effectiveness of Proprioceptive Neuromuscular Facilitation in improving Dynamic Balance in Diabetic Neuropathy.
2. To study the effectiveness of Simple Balance Training in improving Dynamic Balance in Diabetic Neuropathy.

The objective of the study is to compare the effect of Proprioceptive Neuromuscular Facilitation (Group A) and Simple Balance Training (Group B) in improving Dynamic Balance in Diabetic Neuropathy.

Hypothesis

HYPOTHESIS:

NULL HYPOTHESIS (H_0):

There is no significant difference between the Proprioceptive Neuromuscular Facilitation (Group A) and Simple Balance Training (Group B) in improving Dynamic Balance in Diabetic Neuropathy.

ALTERNATE HYPOTHESIS (H_A):

There is a significant difference between the Proprioceptive Neuromuscular Facilitation (Group A) and Simple Balance Training (Group B) in improving Dynamic Balance in Diabetic Neuropathy.

Operational Definitions

OPERATIONAL DEFINITIONS:

Functional reach test (FRT):

The Functional Reach Test is a single item test developed as a quick screen for balance problems in older adults.[2]

Interpretation:

A score of 6 or less indicates a significant increased risk for falls.
A score between 6-10 inches indicates a moderate risk for falls.

Timed up and go test (TUG):

One of the measures of function which correlates to balance and fall risk[23]

Interpretation:

≤ 10seconds=normal

≤ 20seconds=good mobility, can go out alone, mobile without gait aid

≤ 30seconds=problems, cannot go outside alone, requires gait aid

A score of ≥ 14seconds has been shown to indicate high risk of falls.

Review of Literature

REVIEW OF LITERATURE:

1. *Shaham et al 1986*, conducted a study on, "Stroke rehabilitation, three exercise therapy approaches". In this study, the only outstanding result was the pattern of muscle tone in the PNF treatment group.[1]
2. *Duncan et al 1992,* conducted a study on "Functional Reach: Predictive validity in a sample of elderly male veterans". They concluded that functional reach is a simple and easy to use clinical measure that has predictive validity in identifying falls.[2]
3. *Franchigoni et al 1998,* conducted a study on "Reliability of four simple quantitative tests of balance and mobility in healthy elderly females". In conclusion, their overall result suggest that the items making up these four test 1. Sharpened Romberg test, 2. One leg stance test, 3. Functional reach test, 4. Sit to stand test possibly belong to the same domain, and provide reliable raw scores.[3]
4. *Jonsson et al 2002,* conducted a study on "Does the functional reach test reflect stability limits in elderly people?". In this study the correlation between reach distance and displacement of CoP suggests that FRT does not reflect the stability limits in healthy elderly people.[4]
5. *Kalra et al 2003,* conducted a study on "A randomized controlled trial of an enhanced balance training program to improve mobility and reduce falls in elderly patients". This study confirms that exercise programs modified to patients requirements significantly improve balance and mobility, independent of the strategy used. Neverthless, walking speed, quality of life, reported stability and confidence improved more in patients receiving enhanced balance training.[6]
6. *Emery et al 2005*, conducted a study on "Effectiveness of a home-based balance training program in reducing sports-related injuries among healthy adolescents: a cluster randomized controlled trial". They explained that a 6-week home-based proprioceptive balance training program is effective in improving static and dynamic balance in healthy adolescents.[7]
7. *Riek et al 2006*, conducted a study on "PNF stretching mechanisms and clinical implications". Their literature clearly supports that PNF is the most effective means to increase ROM by way of stretching, particularly in respect to short term gains in ROM.[8]

8. *McGuine et al 2006,* conducted a study on "The effect of a balance training program on the risk of ankle sprains in high school athletes". This study documented that a balance training program, implemented throughout a sports season, will reduce the rate of ankle sprains by 38% in high school basketball and soccer players.[9]
9. *Hertel et al 2008,* conducted a study on "Review of postural control and lateral ankle instability, Part-II: Is balance training clinically effective?". They concluded that Prophylactic balance and co-ordination training substantially reduced the risk of ankle sprains in athletes, with a greater effect seen in those with a history of sprain.[10]
10. *Padua et al 2009*, did a brief review on "Evidence supporting balance training in healthy individuals: A systemic review". This systemic review provides strong evidence that balance training can improve static and dynamic balance.[11]
11. *Carmeli et al 2009*, conducted a study on, "Reliability and Validity of the modified functional reach test at the sub acute stage post stroke". They concluded that the modified functional reach test while sitting can be reliably measured and serves as a useful outcome measure in individuals with stroke 2-8 weeks post event.[12]
12. *Volkman et al 2009*, conducted a study on, "Factors affecting Functional Reach Scores in youth with typical development". They concluded that the toes to finger methods could be used with scores categorized according to height groups while demonstrating improved reliability.[13]
13. *Pfeifer et al 2010*, conducted a study on "Balance training for neuromuscular control and performance enhancement: A systemic review". They concluded that balance training can be effective for postural and neuromuscular control improvements.[14]
14. *Shin et al 2011,* conducted a study on "Is there a relationship between the Functional Reach Test and Flexibility?". In conclusion, in healthy young adults, improvement of the range of motion of joints by warming up and stretching has little influence on FRT scores.[15]
15. *Akbari et al 2012,* conducted a study on "Do diabetic neuropathy patients benefit from balance training? ". According to the present study findings, diabetic patients who experience peripheral neuropathy and consequent balance problems can achieve better balance and stability through progressive balance training with emphasis on the anterior-posterior neuromuscular elements of stability.[16]

16. *Herman et al 2012,* conducted a study on "Use of the Michigan neuropathy screening instrument as a measure of distal symmetrical peripheral neuropathy in type 1 diabetes: results from the diabetes control and complications trial/epidemiology of diabetes interventions and complications". They concluded that altering the cut point to define an abnormal test from $\geq$7 abnormal to $\geq$4 abnormal items improves the performance of the MNSI questionaire. The MNSI is a simple, non-invasive and valid measure of distal symmetrical peripheral neuropathy in type 1 diabetes.[17]

17. *Arastoo et al 2012,* conducted a study on "Functional Balance in elderly with diabetic neuropathy". In conclusion, Distal Sensorimotor Polyneuropathy (DPN) results in a remarkable functional imbalance that may expose those patients to danger of falling during daily activities and becomes more severe as the severity of neuropathy aggravates.[18]

18. *Goncalves et al 2012,* conducted a study on " proprioceptive Neuromuscular Facilitation improves balance and knee extensors strength of older fallers". The main result observed on results is that balance improved around 20% on training group after PNF training, while no differences were found for CG after this period.[19]

19. *Sartor et al 2012,* conducted a study on "Effects of a combined strengthening, stretching and functional training program versus usual care on gait biomechanicsand foot function for diabetic neuropathy: a randomizedcontrolled trial". This approach intends to recover at least some of the specific deficits caused by DPN and to promote the motor integration of peripheral gains into foot rollover during gait, redistributing plantar pressures in the task.[20]

20. *Lee et al 2014,* conducted a study on "The effects of combination patterns of PNF and ball exercise on pain and muscle activity of chronic low back pain patients". This study results can be a clinical foundation for the effectiveness of exercise treatment for trunk muscle stabilization of patients with chronic low back pain.[21]

21. *Panich et al 2015,* conducted a study on "Effect of four week Simple Balance exercise on balance ability in Thai Elderly". This study results indicated that the designed balance training programme used in this study has shown successfully beneficial effect by improving static balance and functional mobility (increasing SLBT and decreasing TUGT time) in the elderly.[22]

22. *Seo et al 2015*, conducted a study on "The effects of ramp gait exercise with PNF on stroke patients dynamic balance". They concluded that, ramp gait training with PNF improved stroke patients dynamic balance ability and a good outcome of ramp gait training with PNF is also expected for other neurological disease patients.[23]

23. *Mibs et al 2016*, conducted a study on "The prognostic validity of the Timed up and go test with a dual task for predicting the risk of falls in the elderly". They concluded that the TUG_{cog} is a valid prognostic assessment to predict falls in community-dwelling elderly people.[24]

24. *Silva et al 2017*, conducted a study on "Effect of Proprioceptive Neuromuscular Faciltation (PNF) protocol on the postural balance of older women". Their study concluded that older people showed a tendency to decrease plantar support areas and a significant improvement in static and dynamic balance after the four-week PNF protocol.[25]

25. *Berry et al 2017*, conducted a study on "Strength & Balance training for adults with peripheral neuropathyand high risk of fall: current evidence and implications for future research". The evidence demonstrates that strength and balance training is safe and effective at reducing falls and improving lower extremity strength and balance in adults over 50yrs of age, who are at high risk for falls, including persons with diabetic peripheral neuropathy.

Methodology

METHODOLOGY:

- **Study design:**

  Comparative study

- **Study setting:**

  The study was done in 3 private outpatient clinics in chennai

- **Source of data:**

  Data was collected from 3 private outpatient clinics in chennai. All subjects were assessed and selected based upon who fulfilled the inclusion criteria. The purpose of the study was explained to all subjects and consent from each subject was taken. The subjects were randomly assigned into the either of Proprioceptive Neuromuscular Facilitation techniques (Group-A) and Simple Balance Training (Group-B).

- **Sample size:**

  30 subjects

❖ Inclusion criteria:

- Age group 50-70 years
- Diabetic
- Michigan Neuropathy Screening Instrument score ≥7 to ≥4

❖ Exclusion criteria:

- Foot ulcers
- Vision impairment
- History of dizziness
- Internal otitis (Labyrinthitis)
- Any other vestibular diseases
- Musculo-skeletal disorders
- Rheumatic disorders
- Total/Partial amputation of lower extremities
- Fractures
- History of spinal injury/ surgery
- History of lower limb surgery

❖ Procedure:

30 subjects were selected and evaluated using the assessment form, 3m Timed up and Go test and Functional Reach Test. Patients were informed about the procedure, merits and demerits of the treatment. Consent is obtained from each patient for voluntary participation.

Participants were randomly assigned into two groups I.e., Group-A and Group-B. Patients were assessed before the commencement of treatment and also re-assesed after 20 sessions of treatment. The FRT and TUG scores were assessed on the first day before the treatment (Pre-test) and on the last day after the treatment (Post-test).

Group-A: Proprioceptive Neuromuscular Facilitation Techniques

Group-B: Simple Balance Training

Functional Reach Test:

Timed up and go test:

Group-A:

Proprioceptive Neuromuscular Facilitation

The PNF exercise protocol duration was 4 weeks

1st week- 10 Repetitions

2nd week- 10 Repetitions 2 sets

3rd week & 4th week — 10 Repetitions 3 sets

The resistense of the exercises was manually done during the entire range of motion. The three specific principles of PNF used were:

- ✓ Rhythmic initiation
- ✓ Sustain-Relax
- ✓ Reversal of Antagonists

1) First upper and lower limbs were elongated, using Hold-Relax techniques, following the direction of the diagonal.
2) Then, Rhythmic initiation exercises and Reversal of Antagonists were performed to practice the change of direction of the movement.
3) The protocol was initiated with exercises of the upper limbs in the symmetrical bilateral agonist pattern with the diagonal of **flexion-abduction-external rotation and internal extension-abduction and rotation.** Then, the **flexion-adduction-external rotation and internal abduction-abduction-rotation diagonal** was performed.
4) Continuing exercises were performed for lower limbs in the symmetrical bilateral antagonist pattern with the diagonal of **flexion-adduction-medial rotation and extension-abduction-lateral rotation**(diagonal that stimulates gait).

5) Then, the **flexion-abduction-medial rotation and lateral extension-adduction-rotation diagonal** was performed, with the knee flexion variant in the flexion patterns and the knee extension variant in the extension patterns.
6) In the lateral decubitus position, shoulder and pelvic girdle exercises in the diagonal **anterior-elevation-posterior-depression,** in a symmetrical and reciprocal manner, aiding in the dissociation of the waist.

Flexion pattern

Extension pattern

Group-B

Simple Balance Training:

All exercises were performed near a stable object (such as horizontal rail, etc) and performed under supervision of a care giver. All exercises were performed for 30-40 minutes per day, 5 days per week for 4 weeks.

1) Walking training section:

- **Tandem walking:** walk heel to toe in a straight in 5m and turn around, and tandem back to the starting position.
- **Sidestep walking:** 5m to the left side and then 5m to right side, return to the starting position (make sure each foot lifts off the floor).
- **Backward walking:** 5m and turn around and backward walk and back to the starting position.

2) Balance training section:

- **Single leg stance and three direction tapping:**

  Three direction consists of forward,sideward and backward direction. Standing on two legs in facing the wall position about 1m. Lift right foot off of the floor and tap in forward (distance of tapping equal 1 phase of leg) and return to starting position.

  Following this process in the sideward and backward direction (when participants finish the three directions will be counted as one time).

  Following this process in the left leg

  10 times per set

  Perform 3 sets per leg

3) **Muscle strength training section:**

- **Modified chair stand exercise:**

Sitting on the chair with both foot contacting the floor.

Standing up from the chair but don't full stand, (height of rise from the chair is about 15cm).

And return to sitting position.

Following this process in 10 times per set and perform 3 sets

Tandem walking

Single leg standing

Data Analysis and Interpretations

DATA ANALYSIS AND INTERPRETATION:-

Paired t test

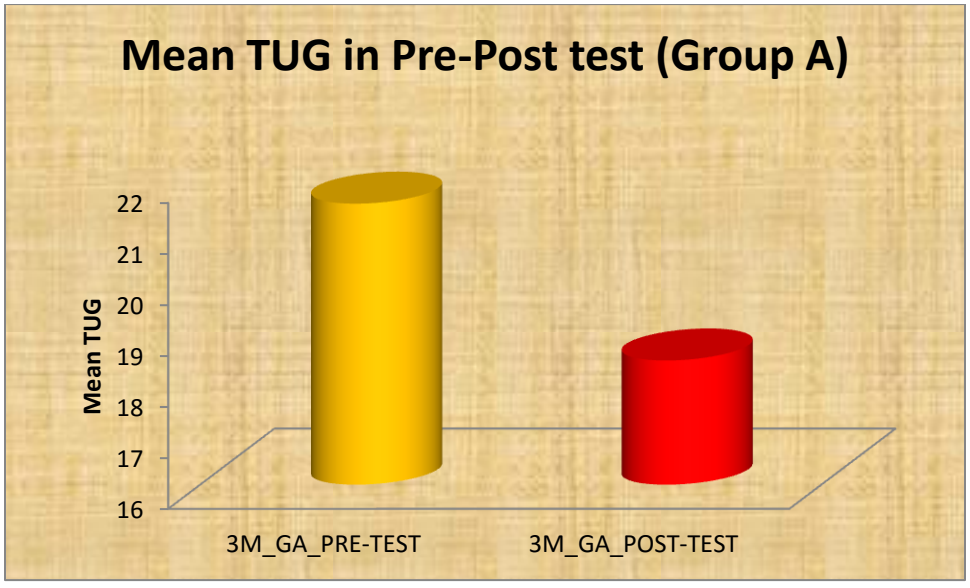
3m Timed up and go test:

Group-A (PNF):

Table.1

Paired Samples Statistics					
Variable	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**	**P-Value**
PRE-TEST	21.511	15	5.298	1.368	0.0001*
POST-TEST	18.436	15	5.243	1.354	

Fig.1

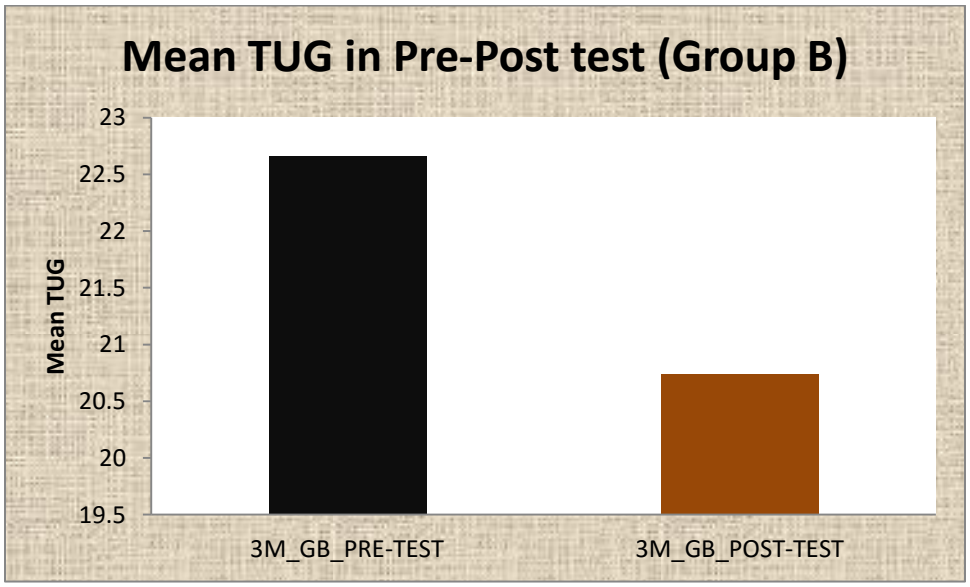


Group-B (Simple balance Training)

Table.2

Paired Samples Statistics					
Variable	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**	**P-Value**
PRE-TEST	22.655	15	6.415	1.656	0.0001*
POST-TEST	20.737	15	6.653	1.718	

Fig.2



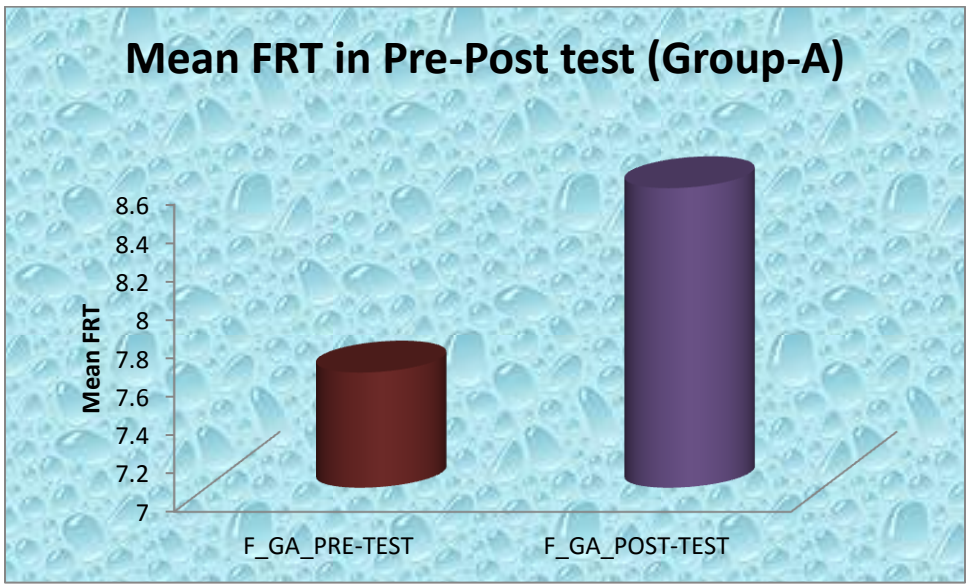
Functional Reach test

Group-A (PNF)

Table.3

Paired Samples Statistics					
Variable	Mean	N	Std. Deviation	Std. Error Mean	P-Value
PRE-TEST	7.600	15	1.617	0.417	0.0001*
POST-TEST	8.560	15	1.761	0.454	

Fig.3

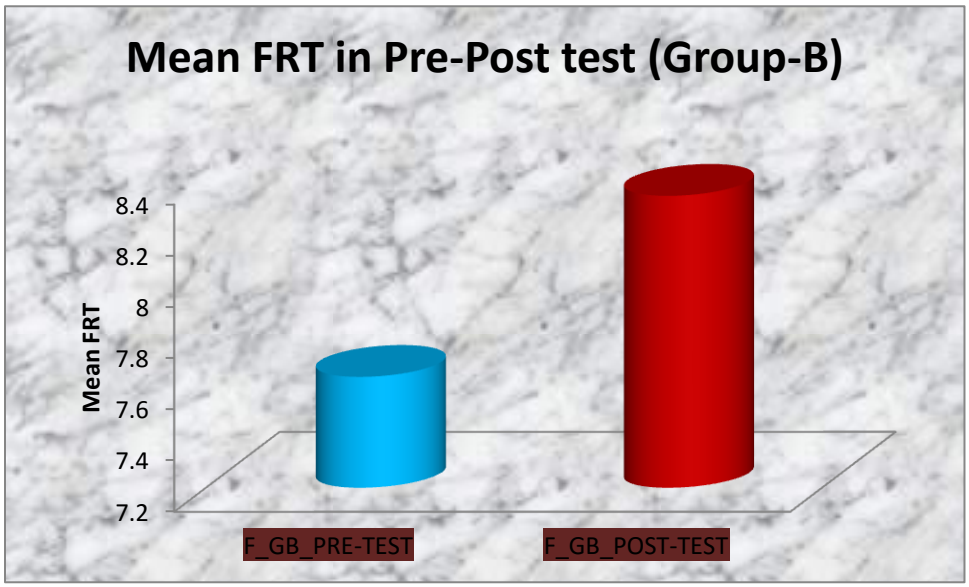


Group-B (Simple Balance Training)

Table.4

Paired Samples Statistics					
Variable	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**	**P-Value**
PRE-TEST	7.633	15	1.840	.475	0.0001*
POST-TEST	8.340	15	1.854	.479	

Fig.4



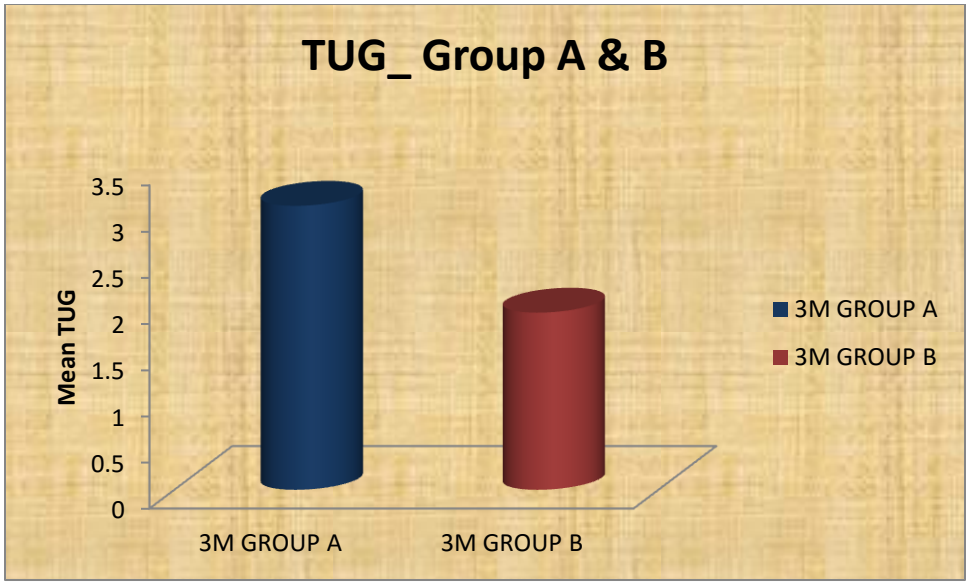
Independent t test:

3m Timed up and go test:

Table.5

	Mean	N	S.D	Std.err	Sig
3M GROUP A	3.075	14	0.939	0.242	.000
3M GROUP B	1.918	14	0.558	0.144	.000

Fig.5

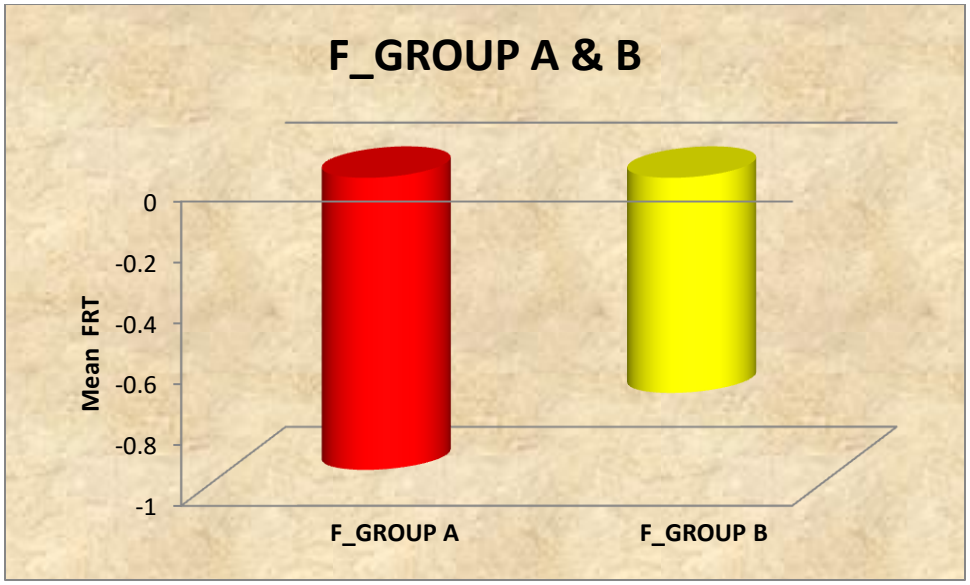


Functional Reach test:

Table.6

	Mean	N	S.D	Std.err	Sig
F_GROUP A	-0.960	14	0.3224903	0.083	.000
F_GROUP B	-0.707	14	0.1162919	0.030	.000

Fig.6



Discussion

Discussion:

Balance is considered to be an important aspect of performance of all individuals, whilst undertaking various daily activities, which is achieved by a complex process involving the functions of musculoskeletal and neurological systems.

A sample of 30 subjects fulfilling the inclusion criteria have randomized into two groups, 15 each in this study.

Group-A underwent Proprioceptive Neuromuscular Facilitation techniques for a period of 4 weeks.

Group-B underwent Simple Balance Training for a period of 4 weeks.

In the early 1990s, Sherrington defined the concepts of neuromuscular facilitation and inhibition, which subsequently led to the development of clinical PNF stretching by Kabat. PNF techniques were used to aid the rehabilitation of clients with spasticity and paresis by either facilitating muscle elongation, supposedly through enhanced inhibitory mechanisms.

A study conducted by **Goncalves et al (2012)** on response to the Proprioceptive Neuromuscular Facilitation in older fallers to improve balance and knee extensors strength. The result of this study supports the present study where the participants balance was increased in terms of Berg Balance scale.

A study conducted by **Silva et al (2017)** on response to Proprioceptive Neuromuscular Facilitation in older women to improve postural balance. The result of this study supports the present study where the participants postural balance was increased in terms of Timed up and go test and Functional Reach test.

A study conducted by **Seo et al (2015)** on response to Proprioceptive Neuromuscular Facilitation in stroke patients to improve dynamic balance. The result of this study supports the present study where the participants dynamic balance was increased in terms of Berg Balance scale, Timed up and go test and Functional Reach test.

From the Table 1. The effectiveness of Proprioceptive Neuromuscular Facilitation in dynamic balance in Diabetic Neuropathy in terms of 3m Timed up and go test, the paired sample t-test, it shows overall effectiveness of 3m Timed up and go test. i.e., **p-value=0.0001<0.05.** Hence, the

evidence is sufficient to conclude that on average, there is significant mean increase in 3mTUG due to the treatment of Proprioceptive Neuromuscular Facilitation.

From the Table 3. The effectiveness of Proprioceptive Neuromuscular Facilitation in dynamic balance in Diabetic Neuropathy in terms of Functional Reach test, the paired sample t-test, it shows overall effectiveness of Functional Reach scale. i.e., **p-value=0.0001<0.05.** Hence, the evidence is sufficient to conclude that on average, there is significant mean increase in FRT due to the treatment of Proprioceptive Neuromuscular Facilitation.

Proprioceptive Neuromuscular Facilitation **are accompanied by great sensory and proprioceptive stimulation.** They use **stretch reflex, manual contact, visual and verbal stimulation, with diagonals that stimulate functional movements**. In the Hold-Relax technique there is increased flexibility and increased range of joint motion and muscle strength. During the execution of the movement, the muscles are briefly stretched before contraction, stimulating the proprioceptors, producing higher levels of strength. This improved the dynamic balance in patients with Diabetic Neuropathy.

A study conducted by **kalra et al (2003)** on response to Enhanced Balance Training in elderly patients to improve mobility and reduce falls. The result of this study supports the present study where the participants mobility and balance was increased in terms of Berg Balance Scale.

A study conducted by **Pfeifer et al (2010)** on response to Balance training for neuromuscular control and performance enhancement. The result of this study supports the present study where the participants postural and neuromuscular control improved in terms of Single leg stance time.

A study conducted by **Panich et al (2015)** on response to simple balance exercise in Thai elderly to improve balance. The result of this study supports the present study where the participants static and dynamic balance was improved in terms of Single leg balance time test and 3m timed up and go test.

From the Table 2. The effectiveness of Simple Balance Training in dynamic balance in Diabetic Neuropathy in terms of 3m Timed up and go test, the paired sample t-test, it shows overall effectiveness of 3m Timed up and go test. i.e., **p-value=0.0001<0.05.** Hence, the evidence is

sufficient to conclude that on average, there is significant mean increase in 3mTUG due to the treatment of Proprioceptive Neuromuscular Facilitation.

From the Table 4. The effectiveness of Simple Balance Training in dynamic balance in Diabetic Neuropathy in terms of Functional Reach test, the paired sample t-test, it shows overall effectiveness of Functional Reach scale. i.e., **p-value=0.0001<0.05.** Hence, the evidence is sufficient to conclude that on average, there is significant mean increase in FRT due to the treatment of Proprioceptive Neuromuscular Facilitation.

Balance is an ability of the human body caused by the interaction of multiple systems, such as sensory system, nervous system and musculoskeletal system. The exercise program focused on **muscle strength in leg muscle, walking and leg movement in different directions, muscle endurance and stretching**. **Balance or sensory-motor training exercises stimulate different parts of the body such as muscles, nerves and brain**. This improved the Dynamic balance in Diabetic Neuropathy.

From the Table 5, Comparison on the effectiveness of two treatments PNF and Simple Balance training in dynamic balance in Diabetic Neuropathy in terms of 3mTUG, the independent sample t-test, it shows that Group A is more effective than Group B in increasing the scores of 3m TUG with a mean value of **3.075.**

From the Table 6, Comparison on the effectiveness of two treatments PNF and Simple Balance training in dynamic balance in Diabetic Neuropathy in terms of FRT, the independent sample t-test, it shows that Group A is more effective than Group B in decreasing the scores of FRT with a mean value of **-0.960**.

The PNF techniques have increased the dynamic balance by improving the **Proprioception, sensory-motor functions and muscle stabilizations.**

Therefore, **Proprioceptive Neuromuscular Facilitation is more effective in improving the dynamic balance in Diabetic Neuropathy.**

Conclusion

Conclusion:

Going by the results of the analysis, we see that both the PNF and Simple Balance Training exercises are individually effective in increasing the scores of FRT and reducing the scores of TUG. That is the scores of all the standard measures

i. FRT are significantly increased
ii. TUG are significantly reduced,

due to the either treatments of the PNF and Simple Balance Training. However, by comparing the increase and decrease in scores of standard measures due to these two treatments, it was found that the treatment of PNF is more effective in terms of decreased TUG scores and increased FRT scores.

On the whole, we conclude that the PNF is found to be more effective than Simple Balance Training in terms of decreasing the scores of TUG and increasing the scores of FRT in dynamic balance in Diabetic Neuropathy.

Limitations

Limitations:

- The sample size was limited
- No control group present
- Treatment duration was short

Recommendations

Recommendations:

- The future studies need to be done with larger group
- The future studies can be done to improve the activities of daily living of the patients
- The future studies can be done to assess the incidence of fall in Diabetic Neuropathy
- The study can be done with longer duration
- The study can be done with a control group

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Annexure

ANNEXTURE:1

PATIENT CONSENT FORM:

Title of Project: A Comparative Study to find Effectiveness of PNF and Simple Balance Training to Improve Dynamic Balance in Diabetic Neuropathy

Investigator: M. Mathivathani

Purpose of This Research: You are invited to participate in a study on the Comparative Study on the Effectiveness of PNF and Simple Balance Training to Improve Dynamic Balance in Diabetic Neuropathy. From the information collected and studied in this project we hope to learn more about the effects of PNF and Simple Balance Training.

Procedures: With your permission we would like to collect health information about you, including information about your general health and then we will evaluate your balance.Only researchers will have access to the final data, and you can refuse to be part of the study. You can also stop at any point during the study. Your results will never be shared with anyone other than the researchers.

Benefits: You may receive direct benefit from this study. We cannot guarantee that you will receive any benefits from this study.

Extent of Anonymity and Confidentiality: At no time will the researchers release the results of this study to anyone other than individuals working on this study without your written consent. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subject's involved in research.

Compensation: You will not be paid to participate in this study.

Freedom to Withdraw: Your decision whether or not to participate in this study will not affect medical care. If you read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue your participation at any time without penalty. Your identity will not be disclosed in any published and written material resulting from the study.

Subject's Responsibilities: I voluntarily agree to participate in this study. I have the following responsibilities:

- Report to my test sessions on time.
- Report to each test session as scheduled.
- Complete the testing as described to me to by the investigator the best of my ability.
- To be honest about my medical history.

Subject's Permission: I have read the Consent Form and the conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent.

Date :

Subject signature :

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research related injury to the subject, I may contact:

Investigators:

Ms.M. Mathivathani *mathidivya2493@gmail.com*

ANNEXTURE:2

General Evaluation:

Demographic data:

- Name
- Age
- Gender
- Address
- Mobile No
- occupation

Subjective Evaluation:

History Taking:

- Past Medical History
    - History of any surgeries
    - History of any medications taken
    - History of fractures
    - History of presence of any cyst
    - History of Diabetes mellitus
    - History of any Metabolic disorders
    - History of any Endocrine disorders
- Present Medical History
    - Hyperthyroidism
    - Diabetes mellitus
    - Hypertension
- Past Physiotherapy History
    - Fracture management
    - Low back pain
    - Any marked muscle spasm

- Myofascial pain
- Intervertebral disc prolapse
- Cervical spondylosis
- Lumbar spondylosis/Sciatica

- Personal History
  - Smoking
  - Alcoholism
  - Tobacco chewing
- Vital signs
  - Heart rate
  - Respiratory rate
  - Blood pressure
  - Temperature

Objective Evaluation:

- On Observation
  - Built of the subject
  - Attitude of the limbs
  - Any sweeling
  - Any angulations
  - Open wounds
  - Surgical scar
  - Healed scar
  - Posture: Normal/ Lordotic/ Scoliotic/ Kyphotic
  - Gait: Normal/ Abnormal
- On Palpation
  - Swelling type
  - Tenderness
  - Bony prominences
  - Bony projections

- Muscle spasm
- Muscle wasting
- Contractures

➢ On Examination

- Sensory examination
  - ✓ Pain
  - ✓ Touch
  - ✓ Pressure
- Motor examination
  - ✓ Muscle power
  - ✓ Range of motion
- Posture
- Gait
- Michigan Neuropathy Screening Instrument
- 3m Timed up and go test

S. No	Date	Pre-Test	Post-Test

- Functional Reach test

S. No	Date	Pre-Test	Post-Test

ANNEXTURE:3

MASTER CHART:

GROUP-A (PNF)

S. No	3m Timed up and go test(in seconds)		Functional Reach test(in inches)	
	Pre-test	Post-test	Pre-test	Post-test
1	20.1	17.21	8.2	9.7
2	17.12	15.59	6.8	8
3	30.46	26.85	8.3	9.2
4	25.58	23.38	7.1	8.5
5	19.36	16.86	5.7	6.3
6	14.39	10.03	9.1	10.2
7	24.11	20.56	4.7	5.1
8	29.33	25.97	6	7.3
9	16.74	12.32	8.8	9.7
10	18.25	16.07	10.1	11.3
11	19.52	16.24	9.8	10.7
12	18.1	15.73	7.7	8.6
13	27.38	24.95	9	9.8
14	26.95	22.18	6.8	7.3
15	15.28	12.6	5.9	6.7

GROUP-B (Simple Balance Training)

S. No	3m Timed up and go test(in seconds)		Functional Reach test(in inches)	
	Pre-test	Post-test	Pre-test	Post-test
1	15.52	13.69	7.8	8.4
2	20.85	18.05	5.1	5.8
3	17.12	15.53	9	10
4	19.63	16.75	6.4	7.1
5	16.78	14.97	10.5	11.2
6	26.89	25.16	7.8	8.5
7	31.21	29.34	6.7	7.3
8	36.55	35.45	8.5	9.2
9	21.25	19.99	4.3	5
10	15.37	13.19	5.7	6.5
11	27.67	25.37	8.8	9.6
12	22.62	20.5	9.5	10.3
13	30.23	29.02	10.1	10.7
14	18.82	16.23	6.3	7
15	19.31	17.81	8	8.5